Spectroscopic diagnostics of underwater plasma jet based on pin-hole configuration

F. Krčma[1], B. Obradović[2]*

[1]Faculty of Chemistry, Brno University of Technology, Purkynova 118, Brno 612 00 Czech Republic

[2]University of Belgrade, Faculty of Physics, Studentski trg 12, 11001 Belgrade, Serbia
*Contact e-mail: obrat@ff.bg.ac.rs

1. Introduction

Over the past years, underwater electrical discharges have received a lot of attention in view of possible applications in different fields of science and technologies, such as advanced oxidation of water pollutions, sterilization, etc. There are a number of techniques for producing underwater plasmas. One of them is to ignite a discharge inside a bubble preliminarily generated by Joule heating, like in a pin-hole discharge configuration. The pin-hole is a systems where the discharge is created inside a small orifice connecting two chambers filled by any conductive solution [1,2]. Based on the experience with this system, a new plasma jet configuration was developed very recently. This system is more suitable for spectroscopic diagnostics of the plasma created in the bubbles.

2. Experimental setup

The configuration of this jet is shown in Fig. 1. It allows operation at relatively low high voltage using DC, AC, high frequency as well as RF power supplies. The prototype consists of copper envelope as an outer grounded electrode, dielectric body from Macor ceramics and tungsten high voltage inner electrode. The DC jet of positive polarities in NaCl solutions of two conductivities (150 and 750µScm^{-1}) was used for the presented study.

The emission spectra were recorded in steps of 0.5mm in axial direction using Jobin Yvon Triax 550 spectrometer with a liquid nitrogen cooled CCD detector. The spectra were recorded using a long integration time, up to 10 s to minimize influence of the discharge self-pulsing character.

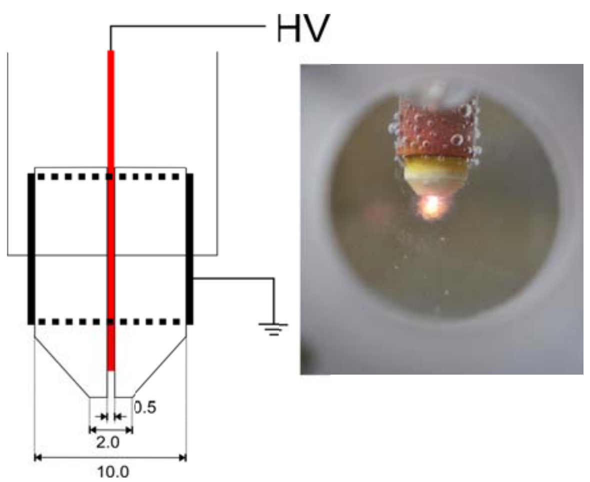

Fig. 1: *Schematic drawing of the plasma jet and the photo of the plasma jet.*

3. Results

The plasma rotational temperature is measured using Boltzmann plot technique applied on OH (A-X) system. Electron temperature is calculated from H_β and H_γ line intensities. The electron number density is calculated using broadening of the H_β line profile and simple deconvolution procedure for resolving Stark broadened part from van der Waals (calculated using plasma rotational temperature and estimation of 1 atm pressure inside the bubble) and instrumental ones. Results of electron number density for two solution conductivities are presented in Fig. 2.

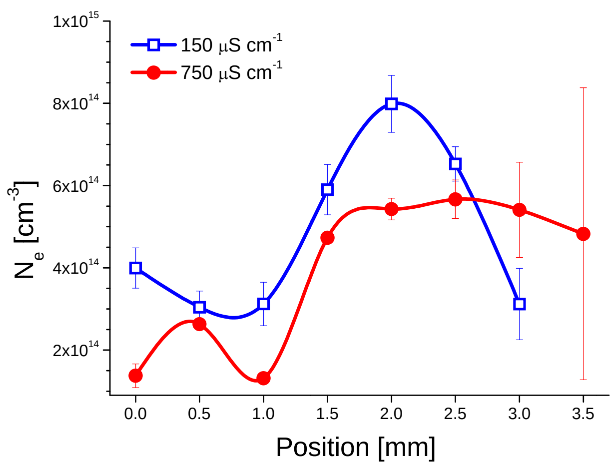

Fig. 2: *Axial distribution of electron number density of the underwater jet produced plasma.*

References

[1] F. Krcma, Z. Kozakova, M. Vasicek 2015 Open Chem.13, 620

[2] Z. Kozakova, F. Krcma, M. Vasicek, L. Hlavata, L. Hlochova 2015 Eur. J. Phys. D – accepted

Acknowledgement

This research was done under STSM support of the COST Action TD1208 and Czech Ministry of Education, Youth and Sports, project No. LD140114.